Technology Maturity: Developmental Test and Evaluation Role in Acquisition Program Success

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Immature technology is one of many problems in defense acquisition, resulting in increased program costs, delayed schedules, and decreased system performance. Several studies in recent years have accentuated that fact. For instance, a March 2005 General Accounting Office (GAO) report (GAO-05-301) stated, "Programs that started development with immature technologies experienced an average acquisition unit cost increase of nearly 21 percent." That figure presents a stark contrast to the cost increases of programs with mature technologies, which averaged approximately one percent. Technology mismatches also confound development of proper program logistics, maintenance, and repair—impacting system sustainability. Immature technology will often delay development and fielding. The 2005 Defense Acquisition Performance Assessment report referred to the typical technology maturity strategy as a "conspiracy of hope"—planning around immature technologies, hoping they will be ready in time to integrate into the system design.

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Technology maturity (TM) is a component or subsystem level factor, vice system level. Each acquisition program consists of numerous components or subsystems of varying TM, which is one of the many factors that contribute to the overall system *technical* maturity. We sometimes confuse the two phrases when we verbally abbreviate TM by saying, "Tech Maturity."

In response to the emerging consensus regarding the problems affecting the success of acquisition programs, Congress decided to act. Fiscal Year 2006, Public Law 109-163, Section 801 requires the Under Secretary of Defense for Acquisition, Technology and Logistics to certify 11 areas, including requirements, affordability, and that the technologies in acquisition programs for which the Under Secretary is the Milestone Decision Authority have been "demonstrated in a relevant environment" before Milestone B.

The Office of the Deputy Under Secretary of Defense for Science and Technology published the Technology Readiness Assessment (TRA) Deskbook in May 2005. The Deskbook describes technology readiness levels (TRLs) as a way to measure TM. The Deskbook defines TRL 6 as a technology that has been "demonstrated in a relevant environment." In accordance with Public Law 109-163, Section 801, all technologies in an acquisition program should achieve TRL 6 prior to Milestone B. In order to verify program TM, the military component science and technology (S&T) executives perform a TRA, which is forwarded to the Deputy Under Secretary of Defense via the component acquisition executive for review. In the past, this has been done approximately 90 days prior to a Milestone B.

For program managers (PMs), 90 days prior to the milestone is too late to determine the state of program TM. Alignment of the program Systems Engineering Plan, Test and Evaluation (T&E) Strategy (TES), and T&E Master Plan (TEMP) with the program's technology development program is critical. Disciplined T&E should verify TRLs throughout program development, and specifically during the technology development phase before Milestone B. The program TES and TEMP should consider technology maturation plans and should include test events to monitor and verify technology maturation. So enabled, T&E results can serve to quantify program technology risk at system technical reviews.

The TRA Deskbook defines a critical technology element (CTE) as an element that is new or novel, or is being used in a new or novel way, that is necessary to achieve the successful development of a system, its acquisition, or its operational utility. PMs should

determine the current TRL for CTEs as soon as the preliminary system design emerges. For each CTE with a low TRL, PMs should identify more mature alternative technologies (i.e., technology "off-ramps") that may serve as a suitable substitute in the event that the planned technology does not mature rapidly enough to support the program schedule. PMs should use empirical test data to support decisions to drop risky technology, and shift to preplanned alternative technology off-ramps of lesser risk. Schedules should include decision points early enough to permit substitution of a more mature alternative before Milestone B. PMs also should document the ramifications of a technology off-ramp. Such ramifications are likely to include different manning, training, and logistics support, among others. Program sponsors should recognize the value of planning for alternative technologies, in the interest of risk reduction and prevention of technical delays, and should provide adequate funding to support such early duplication of effort.

Changes are pending to the Systems Engineering and Test and Evaluation chapters of the Defense Acquisition Guidebook, and to the Department of Defense (DoD) TRA Deskbook to reflect the practices described above. These practices are nothing new to many PMs, who are already planning for technology development and preplanned technology off-ramps. These practices are particularly well suited for programs using an evolutionary acquisition strategy. If the desired technology does not mature rapidly enough to support the first increment, it can often be deferred to a subsequent increment. It is time for all program managers to emphasize TM. Avoiding technical delays is unequivocally in the best interest of the warfighters. They are the ones who ultimately suffer from the "conspiracy of hope." ❑